Willow Creek Subbasin Assessment and TMDLs

Department of Environmental Quality

May 18, 2004

2. Subbasin Assessment – Water Quality Concerns and Status

Monitoring performed by DEQ has identified several streams in the Willow Creek Subbasin having water quality concerns. All segments except Grays Lake Outlet, Grays Lake to Willow Creek; Rock Creek, headwaters to mouth; and Willow Creek, Grays Lake Outlet to mouth; were included on the original 1998 § 303(d) list. The above mentioned segments were added to the 1998 § 303(d) list by the EPA in 2001.

2.1 Water Quality Limited Segments Occurring in the Subbasin

The Willow Creek Subbasin has twenty water quality limited segments that are included on the Idaho 1998 § 303(d) list. Nineteen of the twenty segments were carryovers from the 1996 § 303(d) list, with Buck Creek as the new addition. DEQ BURP monitoring data for the years of 1993-1996 identified all of the listed segments as not fully supporting their designated beneficial uses. The 303(d) segments were listed based on having low stream macroinvertebrate index (SMI), stream habitat index (SHI), and stream fish index (SFI) scores based on the second edition Water Body Assessment Guidance (WBAGII). Grays Lake Outlet, Grays Lake to Willow Creek, Rock Creek, headwaters to mouth, and Willow Creek, Grays Lake Outlet to mouth were all added by the EPA to the 1998 § 303(d) list in 2001, with temperature as the pollutant.

Figure 18 shows the 303(d) listed water quality segments in the Willow Creek Subbasin. Table 20 summarizes the 303(d) listed water body, its boundaries, assessment units, water quality limited segment number, listed pollutants, and listing basis.

Table 20. §303(d) Segments in the Willow Creek Subbasin.

Waterbody Name	WQL SEG	Assessment Units of ID1740205	1998 §303(d)[1] Boundaries	Pollutants	Listing Basis
Birch Creek	2042	SK006_02 SK006_03	Headwaters to Willow Creek	Sediment	Low SMI, SFI, and SHI scores
Brockman Creek	2047	SK024_02 SK024_03 SK025_02 SK025_03	Headwaters to Grays Lake Outlet	Nutrient, Sediment	Low SMI, SFI, and SHI scores
Buck Creek	5232	SK012_02 (Mill Creek AU)	Headwaters to Mill Creek	Unknown	Low SMI, SFI, and SHI scores
Corral Creek	2048	SK026_02	Headwaters to Brockman Creek	Sediment, Temperature	Low SMI, SFI, and SHI scores

Waterbody Name	WQL SEG	Assessment Units of ID1740205	1998 §303(d)[1] Boundaries	Pollutants	Listing Basis
Crane Creek	2056	SK014_02 SK014_03	Headwaters to Willow Creek	Sediment	Low SMI and SFI scores
Grays Lake Outlet	2044	SK020_02 SK020_04	Grays Lake to Above Falls	Nutrient, Sediment	Low SMI score
Grays Lake Outlet	2044	SK016_04 SK017_04 SK019_04 SK020_02 SK020_04	Grays Lake to Willow Creek	Temperature*	Low SFI and SMI
Hell Creek	2045	SK029_02 SK029_03	Headwaters to Grays Lake Outlet	Nutrient, Sediment	Low SMI, SFI, and SHI scores
Homer Creek	2050	SK018_02 SK018_03	Headwaters to Grays Lake Outlet	Sediment	Low SMI, SFI, and SHI scores
Lava Creek	2046	SK028_02 SK028_03	Headwaters to Grays Lake Outlet	Sediment, Temperature	Low SFI and SHI scores
Long Valley Creek	2053	SK015_02	Headwaters to Willow Creek	Sediment, Temperature	Low SMI, SFI, and SHI scores
Meadow Creek	2040	SK032_02 SK032_03	Headwaters to Ririe Reservoir	Sediment	Low SMI, SFI, and SHI scores
Mill Creek	2054	SK012_02 SK012_03	Headwaters to Willow Creek	Sediment, Temperature	Low SMI, SFI, and SHI scores
Ririe Lake	2036	SK002_05		Sediment	Low SMI score
Rock Creek (Willow Creek)	2028	SK005_02	Headwaters to Mouth (Birch Creek to Bulls Fork)	Temperature*	Low SMI and SFI
Sawmill Creek	2049	SK027_02	Headwaters to Brockman Creek	Sediment, Temperature	Low SMI, SFI, and SHI scores
Sellars Creek	2051	SK010_03	Confluence of South Fork Sellars to willow Creek	Flow Alteration, Sediment, Temperature	Low SMI score
Seventy Creek	2057	SK011_02	Headwaters to Willow Creek	Flow Alteration, Sediment, Temperature	Low SMI, SFI, and SHI scores

Waterbody Name	WQL SEG	Assessment Units of ID1740205	1998 §303(d)[1] Boundaries	Pollutants	Listing Basis
Tex Creek	2041	SK031_02 SK031_03	Headwaters to Indian Fork	Sediment	Low SMI, SFI, and SHI scores
Willow Creek	2035	SK001_05	Ririe Dam to HUC boundary	Sediment Temperature*	Low SMI and SFI scores
Willow Creek	2037	SK004_05 SK005_05	Grays Lake Outlet to Ririe Reservoir	Sediment Temperature*	Low SMI, SFI, and SHI scores
Willow Creek	2039	SK011_04 SK013_02 SK013_03	Headwaters to Sellars Creek	Sediment Temperature*	Low SMI, SFI, and SHI scores

[1]Refers to a list created in 1998 of waterbodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.
* 2001 EPA temperature addition to the 1998 303(d) list

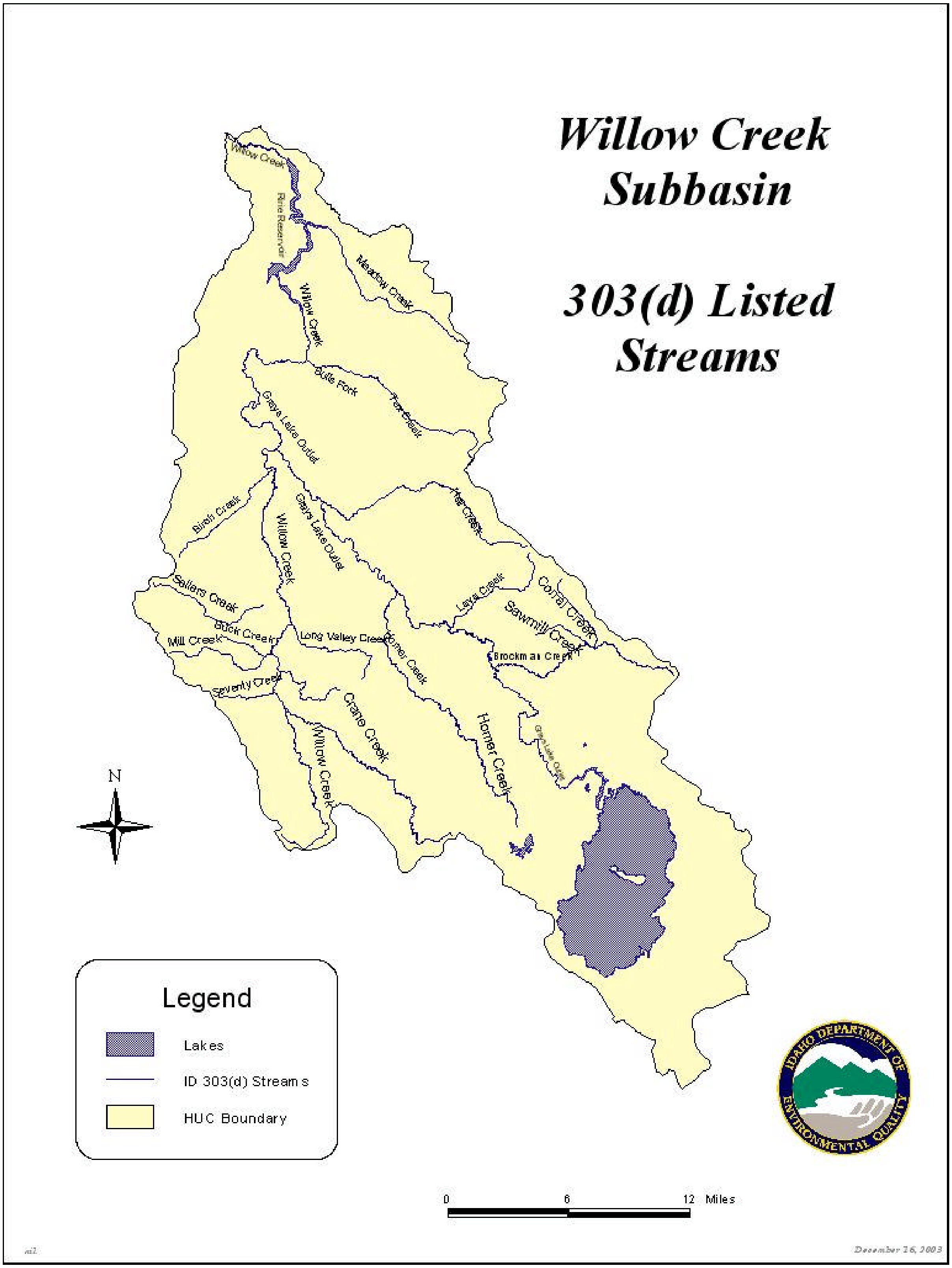

Figure 18. 303(d) listed streams in the Willow Creek Subbasin.

2.2 Applicable Water Quality Standards

Idaho water quality standards are in Idaho's Administrative Procedures Act at IDAPA 58.01.02. Water Quality Standards are legally enforceable rules and consist of three parts: (1) beneficial use designations for the states waters, (2) the numeric and narrative criteria to protect those uses, and (3) an antidegradation policy.

Beneficial Use Designations

Water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). Beneficial uses (BU) are the characteristics of Idaho's streams to be utilized for various purposes, and support status is defined at IDAPA58.01.02.053. The Water Body Assessment Guidance, second edition (DEQ 2002) gives a more detailed description of the procedure for assessing beneficial uses. Beneficial uses are categorized as existing uses, designated uses, and presumed uses. See appendix D applicable water quality standards in their entirety.

Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include uses actually occurring whether or not the level of quality to fully support the uses exists. Practical application of this concept would be when a water could support salmonid spawning, but salmonid spawning is not yet occurring.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho, these include things such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural use. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for waterbodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160 in addition to citations for existing uses.) Table 21 identifies the designated uses for waterbodies in the Willow Creek Subbasin.

Table 21. Willow Creek Subbasin designated beneficial uses.

Waterbody	Water Body Unit (WBID)	Boundaries	Designated Uses[1]	1998 §303(d) List[2]
Willow Creek	US-1	Ririe Reservoir Dam to Eagle Rock Canal	CWAL, SS, and SCR	Yes
Ririe Reservoir (Willow Creek)	US-2		CWAL, SS, PCR, DWS, and SRW	Yes
Willow Creek	US-4	Bulls Fork to Ririe Reservoir	CWAL, SS, RCR, DWS, and SRW	Yes
Willow Creek	US-5	Birch Creek to Bulls Fork	CWAL, SS, PCR, DWS, and SRW	Yes
Willow Creek	US-8	Mud Creek to Birch Creek	CWAL, SS, PCR, DWS, and SRW	No
Willow Creek	US-11	Crane Creek to Mud Creek	CWAL, SS, PCR, DWS, and SRW	Yes
Willow Creek	US-13	Source to Crane Creek	CWAL, SS, PCR, DWS, and SRW	Yes

[1]CWAL – Cold Water Aquatic Life, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply, SRW – Special Resource Water.
[2]Refers to a list created in 1998 of waterbodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

Presumed Uses

In Idaho, most waterbodies listed in the in the water quality standards do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called “presumed uses,” DEQ will apply the numeric criteria cold water and primary or secondary contact recreation criteria to undesignated waters. If in addition to these presumed uses, an additional existing use, (e.g., salmonid spawning) exists, because of the requirement to protect levels of water quality for existing uses, then the additional numeric criteria for salmonid spawning would additionally apply (e.g., intergravel dissolved oxygen, temperature). However, if for example, cold water is not found to be an existing use, a use designation to that effect is needed before some other aquatic life criteria (such as seasonal cold) can be applied in lieu of cold water criteria. (IDAPA 58.01.02.101.01). Table 22 identifies the presumed uses for waterbodies in the Willow Creek Subbasin.

Table 22. Willow Creek Subbasin existing/presumed beneficial uses.

Waterbody	Water Body Unit (WBID)	Boundaries	Existing/Presumed Uses[1]	1998 §303(d) List[2]
Blacktail Creek	US-3	Source to Ririe Reservoir	CWAL and PCR or SCR	No
Birch Creek	US-6	Source to Mouth	CWAL and PCR or SCR	Yes
Squaw Creek	US-7	Source to Mouth	CWAL and PCR or SCR	No
Mud Creek	US-9	Source to Mouth	CWAL and PCR or SCR	No
Sellars Creek	US-10	Source to Mouth	CWAL and PCR or SCR	Yes
Mill Creek	US-12	Source to Mouth	CWAL and PCR or SCR	Yes
Crane Creek	US-14	Source to Mouth	CWAL and PCR or SCR	Yes
Long Valley Creek	US-15	Source to Mouth	CWAL and PCR or SCR	Yes
Grays Lake Outlet	US-16	Hell Creek to Mouth	CWAL and PCR or SCR	Yes
Grays Lake Outlet	US-17	Homer Creek to Mouth	CWAL and PCR or SCR	Yes
Homer Creek	US-18	Source to Mouth	CWAL and PCR or SCR	Yes
Grays Lake Outlet	US-19	Brockman Creek to Homer Creek	CWAL and PCR or SCR	Yes
Grays Lake Outlet	US-20	Grays Lake to Brockman Creek	CWAL and PCR or SCR	Yes
Grays Lake	US-21		CWAL and PCR or SCR	No
Little Valley Creek	US-22	Source to Mouth	CWAL and PCR or SCR	No
Gravel Creek	US-23	Source to Mouth	CWAL and PCR or SCR	No
Brockman Creek	US-24	Corral Creek to Mouth	CWAL and PCR or SCR	Yes
Brockman Creek	US-25	Source to Corral Creek	CWAL and PCR or SCR	Yes
Corral Creek	US-26	Source to Mouth	CWAL and PCR or SCR	Yes
Sawmill Creek	US-27	Source to Mouth	CWAL and PCR or SCR	Yes
Lava Creek	US-28	Source to Mouth	CWAL and PCR or SCR	Yes
Hell Creek	US-29	Source to Mouth	CWAL and PCR or SCR	Yes
Bulls Fork	US-30	Source to Mouth	CWAL and PCR or SCR	Yes
Tex Creek	US-31	Source to Mouth	CWAL and PCR or SCR	Yes
Meadow Creek	US-32	Source to Ririe Reservoir	CWAL and PCR or SCR	Yes

[1]CWAL – Cold Water Aquatic Life, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply, SRW – Special Resource Water.
[2]Refers to a list created in 1998 of waterbodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303, subsection "d" of the Clean Water Act.

Beneficial uses identified for waterbodies for the Willow Creek Subbasin include the following:

- *Cold Water Aquatic Life (CW):* water quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species.

- *Salmonid Spawning (SS):* waters that provide or could provide a habitat for active self-propagating populations of salmonid fishes.

- *Primary contact recreation (PCR):* water quality appropriate for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such activities include, but are not restricted to, those used for swimming, water skiing, or skin diving.

- *Secondary contact recreation (SCR):* water quality appropriate for recreational uses on or about the water and which are not included in the primary contact category. These activities may include fishing, boating, wading, infrequent swimming, and other activities where ingestion of raw water is not likely to occur.

- *Domestic water supply (DWS):* water quality appropriate for drinking water supplies.

- *Special resource waters (SRW):* waters of the state designated as special resource waters.

All designated uses in the Willow Creek Subbasin—CW, SS, PCR, SCR, DWS, and SRW—are assigned to Willow Creek. All other streams in the subbasin are presumed to support CW and PCR or SCR.

Water Quality Criteria

Water quality criteria to protect these beneficial uses include narrative "free form" criteria applicable to all waters (IDAPA 58.01.02.200), and numeric criteria that vary according to beneficial uses (IDAPA 58.01.02.250, 251, and 252). Typical numeric criteria include bacteriological criteria for recreational uses, physical chemical criteria for aquatic life (e.g. pH, temperature, dissolved oxygen, ammonia, toxics, etc), and toxics and turbidity criteria for water supplies.

Of particular importance regarding listed water bodies in this subbasin are the criteria for sediment, temperature, and nutrients.

Sediment

The narrative criterion for sediment is as follows:

> "Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses.

> Determination of impairment shall be based on water quality monitoring and surveillance and the information utilized in Section 350.02.b."

Quantities specified in Section 250 refer to turbidity criteria identified for cold water aquatic life use and small public domestic water supplies. Turbidity must be measured upstream and downstream from a sediment input in order to determine a violation of criteria. The quantitative criterion for turbidity is as follows:

> "Turbidity, below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than fifty (50) NTU instantaneously or more than twenty-five (25) NTU for more than ten (10) consecutive days."

Indirectly, specific sediment criteria also include intergravel dissolved oxygen measures for salmonid spawning uses. Intergravels filled with sediment can't hold enough dissolved oxygen (DO) for successful incubation. Intergravel DO measurement requires the placement of special apparatus in spawning gravels. Turbidity and intergravel DO are rarely measured as part of routine reconnaissance-level monitoring and assessment. These measurements are usually conducted in special cases during higher-level investigations of potential problems. The quantitative criterion for intergravel DO is as follows:

> "(a) One (1) day minimum of not less than five point zero (5.0) mg/L. (b) Seven (7) day average mean of not less than six point zero (6.0) mg/L.

Because of the lack of specific numeric criteria for sediment, surrogate measures are often used as a mechanism to reflect potential sediment problems. Often the percentage of depth fine sediments found in spawning gravels is used as an indicator of sediment problems that will affect salmonid species. Generally, depth fines greater than 28% are considered unhealthful for spawning gravels. Streambank stability can be another indicator of sediment problems in streams. When bank stability falls below 80%, these banks may be contributing unhealthy levels of sediment to aquatic habitats. There are other surrogate measures for sediment, however, caution is advised as specific levels can b e highly variable depending on stream morphology and geology of the area, and it may be difficult to pinpoint levels that are universally acceptable.

Nutrients

The narrative criterion for nutrients is as follows:

> "Excess Nutrients. Surface waters of the state shall be free from excess nutrients that can cause visible slime growth or other nuisance aquatic growths impairing designated beneficial uses."

The measures for excess nutrients that are often examined are total phosphorus (P) and nitrate (NO_3) + nitrite (NO_2) nitrogen. Although there is no maximum level specified by law, it is recommended by the EPA that total phosphorus should not exceed (1) 0.1 mg/L in streams not flowing directly into lakes or reservoirs and (2) 0.05 mg/L in any stream at the point where it enters any lake or reservoir and nitrate (NO_3) + nitrite (NO_2) nitrogen shall not exceed 0.3 mg/L. The desired goal associated with these limits is to prevent eutrophication or nuisance algal growths in the waterbody which can impair beneficial use support.

Temperature

The temperature criteria are dependent upon the aquatic life residing in the waters in question. For the waters in the Willow Creek Subbasin, the numeric temperature criteria for cold water aquatic life and salmonid spawning apply.

The temperature criterion (values not to be exceeded) for cold water aquatic life use is:

- 22°C (66.2°F) or less with a maximum daily average of no greater than 19°C (71.6°C).

The temperature criterion (values not to be exceeded) for salmonid spawning is:

- 13°C (55.4°F) or less with a maximum daily average no greater than 9°C (48.2°F).

Antidegradation Policy

Idaho's Antidegradation Policy (IDAPA 16.01.02.051) states that:

> "Existing instream water uses and the level of water quality necessary to protect existing uses shall be maintained and protected."

The policy makes provisions for degradation when it is "…necessary to accommodate important economic or social development in the area in which the waters are located," though water quality must continue to support beneficial uses.

2.3 Summary and Analysis of Existing Water Quality Data

Water quality data in the Willow Creek Subbasin is available, with multiple government agencies collecting data in the watershed, as shown in appendix E. All continuous flow data was provided by the USGS. Water column data, such as stream temperatures, nutrient, dissolved oxygen (DO), and total suspended sediment, was collected by the following agencies: BLM, USFS, IDFG, and IASCD. DEQ has contributed by collecting temperature, Beneficial Use Reconnaissance (BURP) biological data, streambank erosion inventories, and subsurface sediment sampling. The BLM provided information on the riparian conditions in the watershed. The IDL evaluated general stream health in the subbasin. DEQ, IDFG, USFS, and BLM collected fish data.

Flow Characteristics

Several USGS flow gauge stations are maintained in the Willow Creek Subbasin. Two stations are located on Willow Creek: one below Tex Creek (#13057940) and the other below Ririe Reservoir (#13058000). There are two gauge stations at Grays Lake, one at the Outlet (#13057500) and the other at the Diversion to Blackfoot Reservoir (#13057300). Eighteen years of streamflow data is available for station number 13057940. Data years are 1978-1979 and 1985-2001. Streamflow data is available for station number 13058000 for the water years of 1903-1904, 1917-1928, 1962-2001. Limited data is available for the Grays Lake stations; however, it is useful in determining the quantity of water diverted from the Willow Creek watershed to the Blackfoot Reservoir watershed. Flow data is available for station number 13057300, at the diversion, for 1966-1970 and 2000-2002. Data is available for Gray's Lake Outlet, station number 13057500, through the years of 1916-1925 (before Clark's Cut was constructed), 1956, 1966-1970, and 2002 (May-Sept.).

Willow Creek, below Tex Creek, contributes an annual mean flow of 124 cubic feet per second (cfs) for the years of 1978 and 1986-2000. Figure 19 shows the average annual discharge for Willow Creek station number 13057940. Gaps in the chart represent the years when data was not collected at this station. Table 23 and Figure 20 summarize monthly mean flow statistics for the entire period of record, 1977-1979 and 1985-2001. Streamflows peak in the spring with May's flow average at 450 cfs. The lowest recorded mean monthly flows occur in September at 31.0 cfs (Table 22). Peak streamflow data for station number 13057940 is summarized in Table 24. The highest flow on record occurred on May 7, 1997. NRCS Snotel data, discussed in section 1.2, confirms that 1997 was an above average water year.

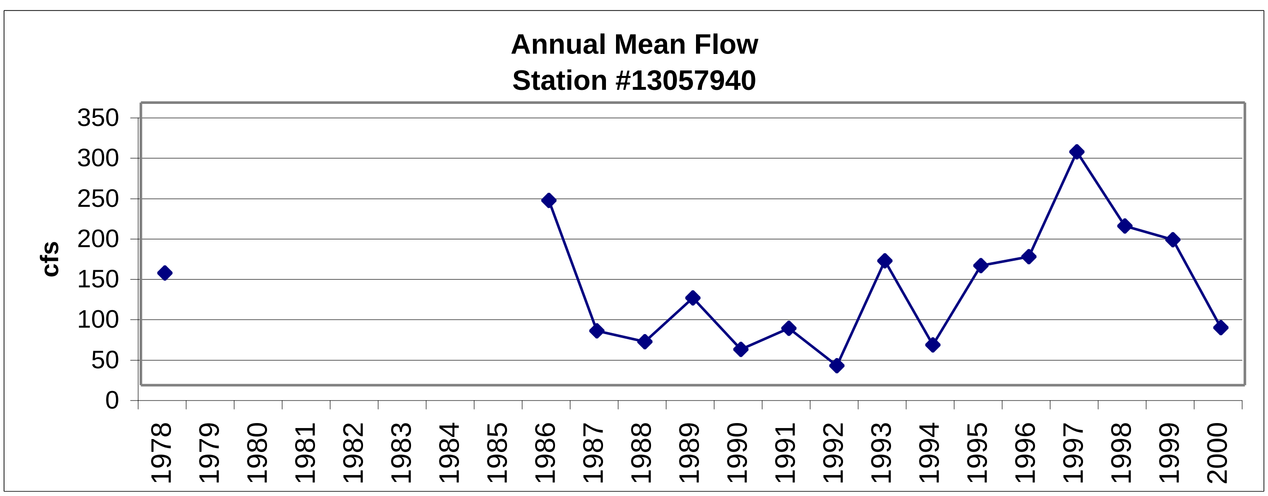

Figure 19. Annual mean flow (cfs) for station #13057940, Willow Creek below Tex Creek near Ririe, ID (1978 and 1986-2000).

Streamflow data from station number 13058000 is heavily influenced by local water needs because the Ririe Reservoir is an impoundment that controls the waters of Willow Creek to provide flood control, irrigation and recreation. Reservoir construction began in 1970 and was completed in 1977. (http://dataweb.usbr.gov/dams/id00344.htm)

Figure 20 shows the annual mean flow for USGS station number 13058000, below Ririe Reservoir. Annual average flow ranges from a high of 378 cfs in 1917 to a low in 24.3 cfs in 1977. Peak streamflow data (Figure 23) shows that the highest flow ever recorded occurred in 1962 (5080 cfs), and the second highest occurrence was in 1917 (4200 cfs). As stated in section 1.2, Willow Creek flood damage experienced in 1917 and 1962 led to the construction and coordinated operation of the Ririe Dam and its floodway bypass channel to control the flows in Willow Creek.

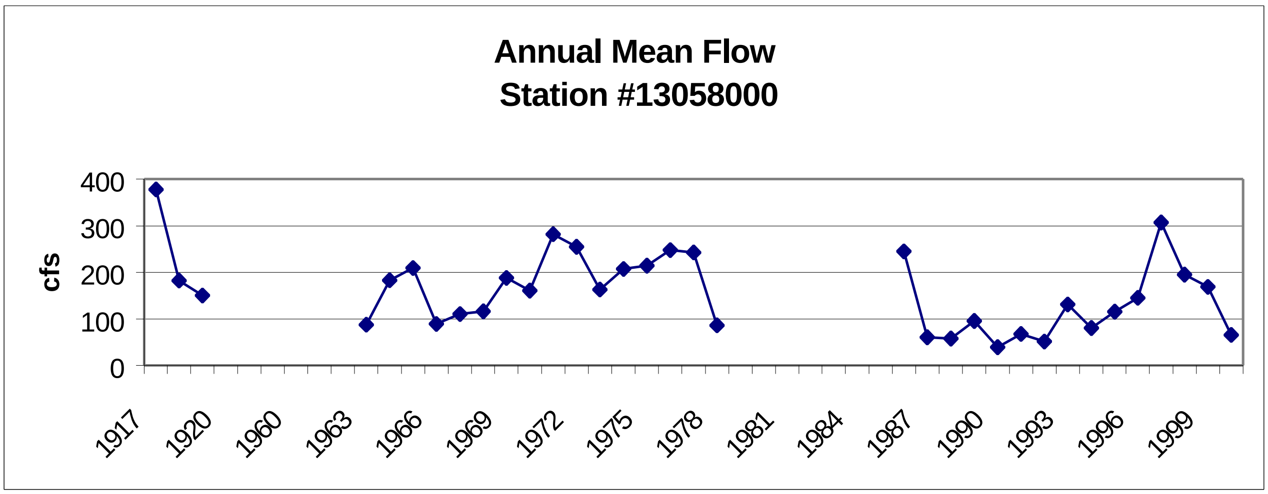

Figure 20. Annual mean flow (cfs) for station #13058000, Willow Creek near Ririe, Id (1917-1919, 1963-1978, and 1986-2000).

Table 23 and Figures 21 and 22 summarize monthly mean flow statistics for the station's reporting time frames. Streamflows below the reservoir tend to peak in May, with a monthly average of 606 cfs, and reach base flows in the winter. Station streamflow data also indicates that flow from the reservoir to Willow Creek is often completely eliminated in the months of December through March.

Table 23. Monthly flow statistics for Willow Creek USGS gauging stations in HUC #17040205.

Station #	Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
13057940	Ave.	42.3	45.1	91.7	343	450	178	62.7	35.6	31.0	39.4	43.9	42.4
	Max.	101	65.1	264	867	1427	409	148	93.1	72.7	73.9	80.0	67.7
	Min.	20.2	20.3	42.7	63.5	25.3	15.2	11.9	3.16	7.38	10.5	16.7	19.5
13058000	Ave.	29.4	35.5	68.5	247	606	286	100	94.0	149	127	59.4	28.8
	Max.	160	98.8	274	750	2133	1325	340	670	610	443	223	91.6
	Min.	0	0	0	0	29.5	30.4	27.8	12.6	16.6	18.4	0	0
13057300	Ave.	0.83	0.49	0.55	19.9	169	178	19.9	1.08	0.48	0.94	2.19	2.22
	Max.	2.48	0.80	0.99	46.0	348	335	65	6.88	1.51	2.24	3.62	5.48
	Min.	0.20	0.17	0.21	0.44	0.13	0.26	0.091	0.01	0	0	0.20	0.20
13057500	Ave.	0.24	0.25	0.27	6.22	215	91	26.9	4.59	1.95	2.33	0.31	0.26
	Max.	0.34	0.38	0.36	12	644	337	45.3	8.34	3.95	10.5	0.31	0.38
	Min.	0.13	0.12	0.1	0.37	0.74	0.74	0.63	0.21	0.15	0.12	0.10	0.13

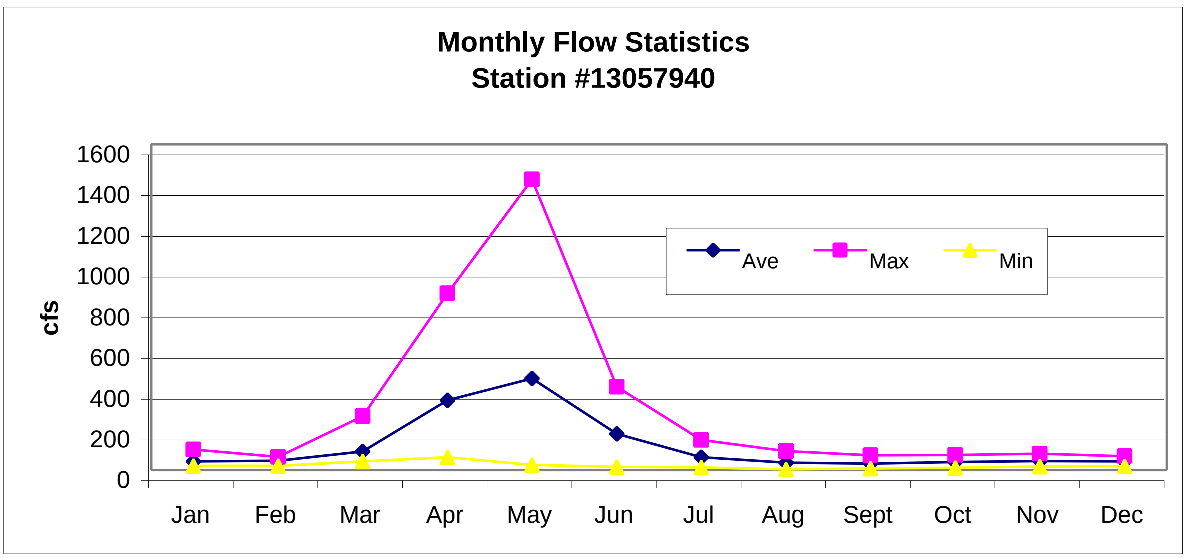

Figure 21. Monthly flow statistics for station #13057940, Willow Creek below Tex Creek near Ririe, ID (1977-1979, 1985-2001).

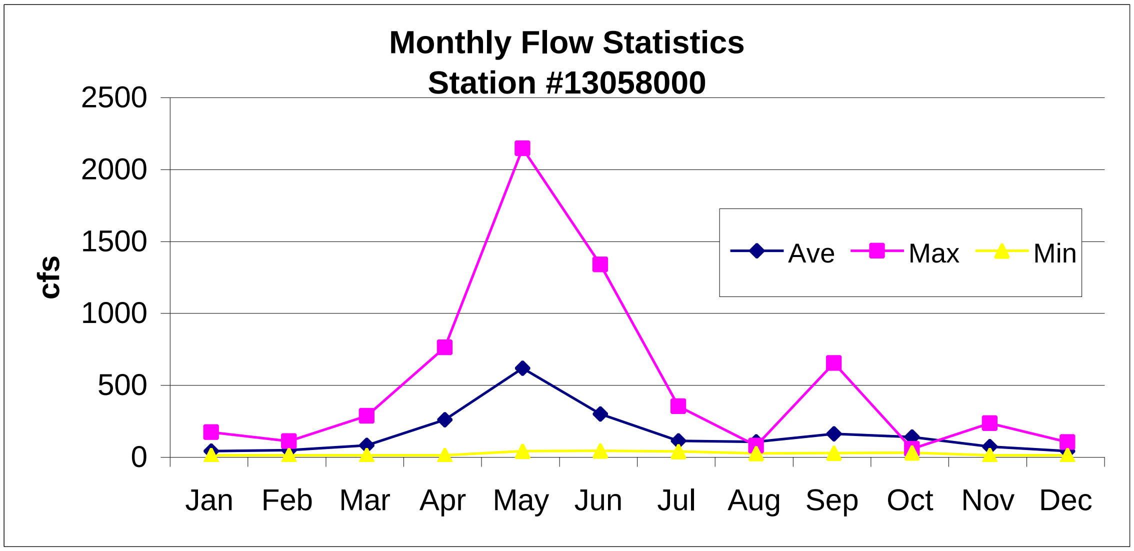

Figure 22. Monthly flow statistics for station #13058000, Willow Creek near Ririe, ID (1903-1904, 1917-1928, and 1962-2001).

Table 24. Peak streamflow (cfs) for station #13057940, Willow Creek below Tex Creek near Ririe, ID (1978-1979, 1986-2001).

Water Year	Date	Stream Flow (cfs)
1978	05/01/78	868[5]
1979	04/30/79	761[5]
1986	04/23/86	1490[5]
1987	04/06/87	495[5]
1988	04/18/88	499[5]
1989	04/21/89	1340[5,B]
1990	04/29/90	309[5]
1991	05/10/91	486[5,B]
1992	04/18/92	94[5]
1993	05/07/93	1460[5]
1994	04/19/94	418[5]
1995	05/07/95	897[5]
1996	05/19/96	1210[5]
1997	05/07/97	2420[5]
1998	05/01/98	1250[5]
1999	04/30/99	1790[5]
2000	04/19/00	580[5]
2001	04/20/01	208[5]

5= Discharge affected to unknown degree by Regulation or Diversion
B= Month or Day of occurrence is unknown or not exact

As shown in Figure 23, the majority of water from Grays Lake is diverted through Clark's Cut Canal to the Ririe Reservoir. In 2002, the USGS recorded a total discharge of 1362.44 cfs for the months of April through September at station number 13057300 (Grays Lake Diversion). This constituted 95 percent of the total discharge from Grays Lake in the 2001-2002 water year. USGS only collects data from the Grays Lake stations in the months of April-September (Bateman 2003).

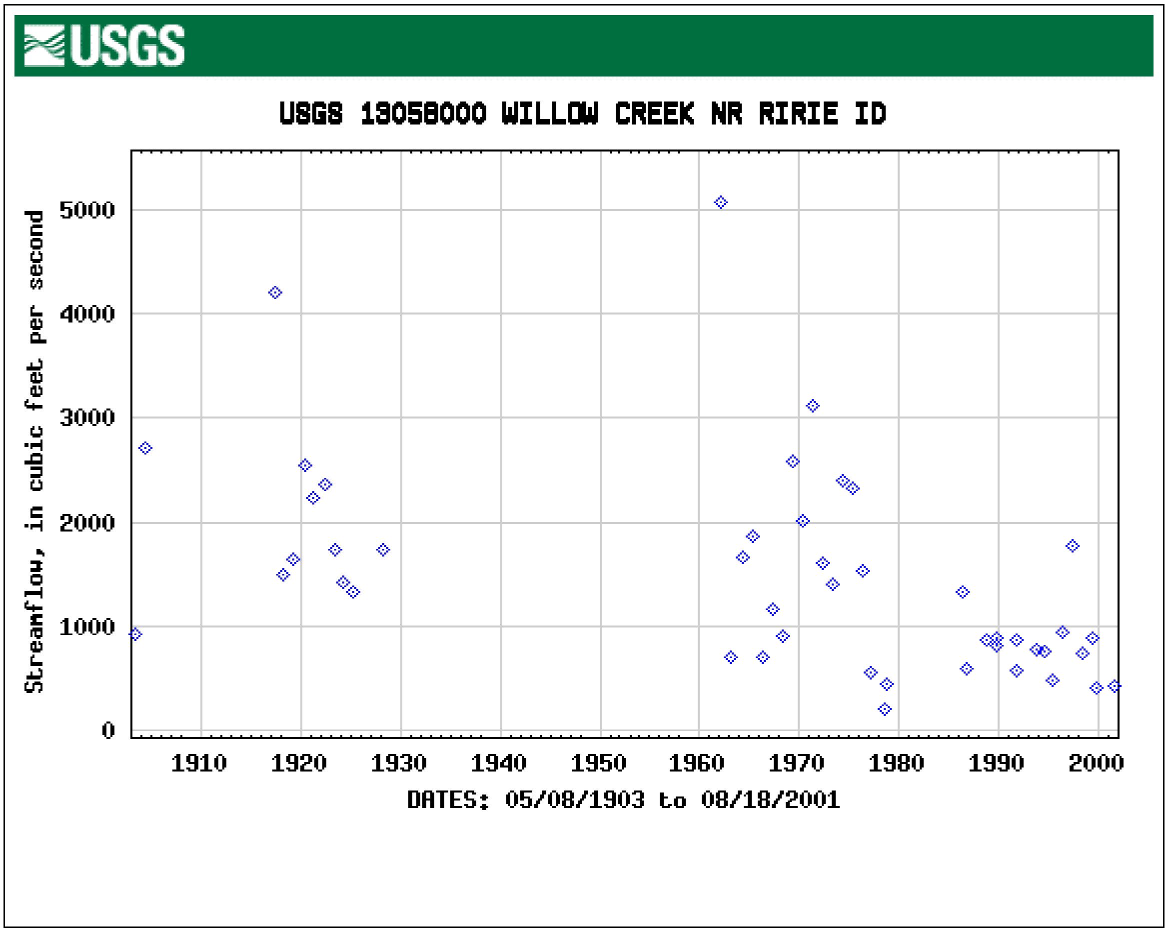

Figure 23. Peak streamflow (cfs) for station # 13058000, Willow Creek near Ririe, ID (1903-2001).

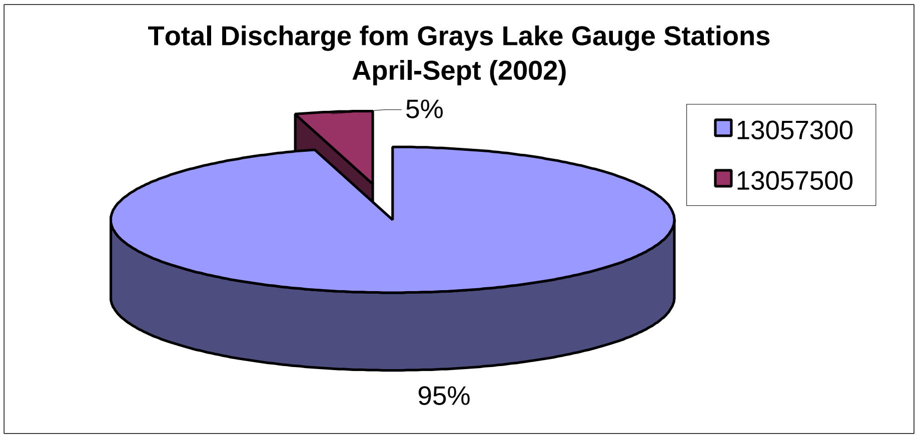

Figure 24. Total discharge from gauge stations at Grays Lake, Outlet (13057500) and Diversion (13057500) for the months of April-Sept. 2002.

Water Column Data

Water column data includes stream temperature, total suspended sediment, and nutrient data, all of which are discussed in the following.

Stream Temperature Data

DEQ, United States Forest Service (USFS), and Idaho Fish and Game (IDFG) have collected stream temperature data in the Willow Creek Subbasin. In 2001, IDFG placed 17 temperature loggers in the Willow Creek watershed. Of the 17 loggers, four contained excessive dry stream data and, therefore, were not used to assess stream temperatures. The four dry streams were Shirley Creek, Brockman Creek, Sawmill Creek, and Homer Creek (upper). The 13 remaining temperature loggers were located in Grays Lake Outlet, Hell Creek, Homer Creek (lower), Sellars Creek, Tex Creek, and Willow Creek. USFS maintained thermograph sampling sites along Brockman Creek (at forest boundary), in 2001 and 2002, and Corral Creek (mouth) in 2000 and 2001. In 2003, DEQ collected thermograph data on Mill, Sellars, Long Valley, Lava, and Sawmill Creeks

Raw stream temperature data was obtained and evaluated for State of Idaho water temperature criteria for all of these sites. These criteria are in two categories: cold water aquatic life (CWAL) and salmonid spawning (SS). The temperature criteria for CWAL is 22°C (66.2°F) or less, with a maximum daily average of no greater than 19°C (71.6°C). A CWAL criterion is evaluated for the summer season (June 22 through September 21). The criterion for salmonid spawning is 13°C (55.4°F) or less with a maximum daily average no greater than 9°C (48.2°F). (IDAPA 58.01.02.250.02) According to IDFG, spring SS generally occurs between the first of May through the end of June (Schrader 2003). Fall spawning is known to occur from September 15th through November 15th , although this is an approximation.

A major exceedance of temperature criteria occurs when the criteria are exceeded 10% of the time. A minimum of two measurements must be evaluated before the determination of a violation can be made. See tables 25-30 for temperature exceedances on each site and the thermograph location(s) for each stream. Major exceedances (>10%) are shaded in gray on the tables.

Table 25. 2001 IDFG Temperature data and number of days where water temperatures exceeded the cold water aquatic life criteria during the entire monitoring period.

		Cold Water Aquatic Life						
			22°C Inst.			19°C Daily Ave.		
Stream Name	Date Period	# Days Evaluated	# Days Over	Max Temp	Max Date	# Days Over	Max Temp	Max Date
Grays Lake Outlet	05/28/01-10/21/01	92	55	28.7	03-Jul	38	22.3	04-Jul
Grays Lake Outlet, Bridge	07/14/01-09/23/01	70	14	23.8	19-Jul	26	20.8	07-Aug
Grays Lake Outlet, Mouth	07/14/01-10/05/01	70	7	23.4	14-Aug	14	20.6	14-Aug
Hell Creek	05/28/01-10/21/01	92	0	19.8	05-Jul	0	18.2	06-Jul
Homer Creek	05/28/01-10/21/01	92	75	29.9	02-Sept	4	19.8	04-Jul
Sellars Creek	05/28/01-10/21/01	92	0	18.9	04-Jul	0	14.7	05-Jul
Sellars Creek, South Fork	05/28/01-10/21/01	92	0	22.4	10-Jul	0	15.6	05-Jul
Tex Creek	05/27/01-10/21/01	92	11	24.2	22-Jun	0	18.7	05-Jul
Willow Creek	05/28/01-10/21/01	92	39	25.6	03-Jul	58	23.4	05-Jul
Willow Creek, Cloward's Crossing	07/14/01-09/23/01	70	38	26.7	21-Jul	33	21.4	09-Aug
Willow Creek, Grays Lake Outlet	07/14/01-10/15/01	70	48	26.6	06-Aug	34	21.8	07-Aug
Willow Creek, High Bridge	07/14/01-09/23/01	70	40	24.9	19-Jul	21	20.1	07-Aug
Willow Creek, Pole Bridge	07/14/01-09/23/01	70	3	22.76	06-Aug	21	20.59	07-Aug

Table 26. 2001 IDFG Temperature data and number of days where water temperatures exceeded the salmonid spawning criteria during the entire monitoring period.

		Salmonid Spawning						
			13 Inst.			9°C Daily Ave.		
Stream Name	Date Period	# Days Evaluated	# Days Over	Max Temp	Max Date	# Days Over	Max Temp	Max Date
Grays Lake Outlet	05/28/01-10/21/01	71	52	23.34	28-Jun	52	21.31	30-Jun
Grays Lake Outlet, Bridge	07/14/01-09/23/01	9	9	16.84	15-Sept	9	14.66	5-Sept
Grays Lake Outlet, Mouth	07/14/01-10/05/01	31	20	20.42	15-Sept	22	15.87	15-Sept
Hell Creek	05/28/01-10/21/01	71	30	19.51	25-Jun	41	17.41	24-Jun
Homer Creek	05/28/01-10/21/01	71	55	26.42	28-Jun	51	18.79	24-Jun

		Salmonid Spawning						
			13 Inst.			9°C Daily Ave.		
Stream Name	**Date Period**	**# Days Evaluated**	**# Days Over**	**Max Temp**	**Max Date**	**# Days Over**	**Max Temp**	**Max Date**
Grays Lake Outlet	05/28/01-10/21/01	71	52	23.34	28-Jun	52	21.31	30-Jun
Grays Lake Outlet, Bridge	07/14/01-09/23/01	9	9	16.84	15-Sept	9	14.66	5-Sept
Grays Lake Outlet, Mouth	07/14/01-10/05/01	31	20	20.42	15-Sept	22	15.87	15-Sept
Hell Creek	05/28/01-10/21/01	71	30	19.51	25-Jun	41	17.41	24-Jun
Homer Creek	05/28/01-10/21/01	71	55	26.42	28-Jun	51	18.79	24-Jun
Sellars Creek	05/28/01-10/21/01	71	22	18.07	29-Jun	25	13.19	30-Jun
Sellars Creek, South Fork	05/28/01-10/21/01	72	31	22.44	10-Jun	48	15.12	23-Jun
Tex Creek	05/27/01-10/21/01	72	42	23.33	23-Jun	49	17.96	23-Jun
Willow Creek	05/28/01-10/21/01	71	51	24.54	30-Jun	57	21.97	30-Jun
Willow Creek, Cloward's Crossing	07/14/01-09/23/01	9	9	19.76	15-Sept	9	16.69	19-Sept
Willow Creek, Grays Lake Outlet	07/14/01-10/15/01	31	20	20.19	15-Sept	21	16.35	15-Sept
Willow Creek, High Bridge	07/14/01-09/23/01	9	9	18.58	15-Sept	9	14.81	15-Sept
Willow Creek, Pole Bridge	07/14/01-09/23/01	9	9	16.72	15-Sept	9	14.92	51-Sept

Table 27. 2000, 2001, 2002 USFS Temperature data and number of days where water temperatures exceeded the cold water aquatic life criteria during the entire monitoring period.

		Cold Water Aquatic Life						
			22°C Inst.			19°C Daily Ave.		
Stream Name	**Date Period**	**# Days Evaluated**	**# Days Over**	**Max Temp**	**Max Date**	**# Days Over**	**Max Temp**	**Max Date**
Brockman Creek, Forest Boundary	06/12/01-09/04/01	75	0	19.9	14-Aug	0	16.34	22-Jun
Brockman Creek, Forest Boundary	06/20/02-09/10/02	81	0	20.5	12-Jul	0	18.2	08-Jul
Corral Creek, Mouth	07/07/00-09/27/00	64	42	26.9	30-Jul	4	21.9	21-Sept
Corral Creek, Mouth	06/20/02-09/10/02	81	22	25.4	12-Jul	20	21.4	15-Jul

Table 28. 2000, 2001, 2002 USFS Temperature data and number of days where water temperatures exceeded the salmonid spawning criteria during the entire monitoring period.

		Salmonid Spawning						
			13°C Inst.			9°C Daily Ave.		
Stream Name	Date Period	# Days Evaluated	# Days Over	Max Temp	Max Date	# Days Over	Max Temp	Max Date
Brockman Creek, Forest Boundary	06/12/01-09/04/01	19	17	19.54	29-Jun	19	17.30	24-Jun
Brockman Creek, Forest Boundary	06/20/02-09/10/02	11	11	19.70	30-Jun	11	17.84	29-Jun
Corral Creek, Mouth	07/07/00-09/27/00	7	7	22.39	21-Sept	7	21.95	21-Sept
Corral Creek, Mouth	06/20/02-09/10/02	11	11	22.82	30-Jun	11	19.46	30-Jun

USFS thermograph data (tables 27 and 28) show that there were major exceedances of CWAL criteria at the mouth of Corral Creek in 2000 and 2002. However, potentially dewatered stream conditions may play a role in documented exceedances. Major exceedances in SS occurred on Corral and Brockman Creeks on both data collection events.

Homer Creek, 303(d) listed for nutrients and sediment—not for temperature, had major exceedances in CWAL and SS criteria. Hell and Tex Creeks, 303(d) listed for sediment—not for temperature, show major exceedances in SS criteria. Coldwater aquatic life criteria were exceeded throughout Willow Creek. Brockman Creek, from headwaters to Grays Lake Outlet is 303(d) listed for nutrient and sediment, not for temperature. USFS thermograph data show that SS temperature criteria exceedances were documented in 2001 and 2002.

Table 29. 2003 DEQ Temperature data and number of days where water temperatures exceeded the cold water aquatic life criteria during the entire monitoring period.

		Cold Water Aquatic Life						
			22°C Inst.			19°C Daily Ave.		
Stream Name	Date Period	# Days Evaluated	# Days Over	Max Temp	Max Date	# Days Over	Max Temp	Max Date
Lava Creek, Dan Creek Rd	05/07/03-09/25/03	92	20	24.8	07-Jul	2	19.89	25-Jul
Long Valley Creek, Rd x-ing	05/07/03-07/21/03	30	0	21.3	21-Jul	0	18.6	21-Jul
Mill Creek, Res. Rd X-ing	05/07/03-10/27/03	92	36	25.9	21-Jul	7	20.73	21-Jul
Sawmill Creek, Brockman Rd	05/07/03-08/06/03	46	12	24	12-Jul	0	18.77	30-Jun
Sellars Creek, Res. Rd	05/07/03-10/26/03	92	51	27.9	21-Jul	22	22.04	21-Jul

Table 30. 2003 DEQ Temperature data and number of days where water temperatures exceeded the salmonid spawning criteria during the entire monitoring period.

		Salmonid Spawning						
			13°C Inst.			9°C Daily Ave.		
Stream Name	**Date Period**	**# Days Evaluated**	**# Days Over**	**Max Temp**	**Max Date**	**# Days Over**	**Max Temp**	**Max Date**
Lava Creek, Dan Creek Rd	05/07/03-09/25/03	66	53	22.8	30-Jun	53	18.44	18-Jun
Long Valley Creek, Rd x-ing	05/07/03-07/21/03	55	38	18.2	30-Jun	45	16.04	30-Jun
Mill Creek, Res. Rd	05/07/03-10/27/03	98	61	24	30-Jun	72	18.2	30-Jun
Sawmill Creek, Brockman Rd	05/07/03-08/06/03	55	44	22.1	18-Jun	48	18.77	30-Jun
Sellars Creek, Res. Rd	05/07/03-10/26/03	97	50	26.7	30-Jun	68	18.51	30-Jun

Willow Creek, Grays Lake Outlet, Rock Creek, Lava Creek, Corral Creek, Sawmill Creek, Sellars Creek, Long Valley Creek, Mill Creek, and Seventy Creek are 303(d) listed with temperature as a pollutant. Sawmill Creek is listed from headwaters to Brockman Creek. DEQ 2003 thermograph data documented major exceedances in SS criteria. Sellars Creek is listed from the confluence with South Fork Sellars Creek to Seventy Creek. IDFG temperature data is available above the listed reach on South Fork Sellars Creek and on the listed reach at the Ririe Reservoir Road crossing. In both cases, major exceedances of the SS criteria were documented. Two USFS thermographs were placed on the listed reach of Corral Creek in 2000 and 2002. In both cases, there were major temperature exceedances for SS criteria in Corral Creek. Thermograph data is available for Grays Lake Outlet and Willow Creek.

As summarized in tables 25 and 26 major exceedances in CWAL and SS were documented in every location with the exception of Pole Bridge. At Pole Bridge, the major exceedance was for SS only. Stream temperatures were not collected for Rock Creek. The Willow Creek-Kepp’s Crossing sample site is located just below the Rock Creek confluence.

All of the streams sampled by DEQ, IDFG, and USFS had major exceedances of the SS criteria. The data presented in Tables 26, 28, and 30 show the number of days that water temperature exceeded salmonid spawning criteria temperatures. Major exceedances are shaded in gray.

Total Suspended Sediment

Total suspended sediment (TSS) data was collected by the BLM in 1983, 1992, 1994, and 2000. Sample locations were on Willow Creek, Tex Creek, Grays Lake Outlet, and Hell Creek. BLM water quality data collected within the past ten years is shown in Table 31. In 2003 IASCD collected TSS data (Appendix F) on Meadow, Tex, Willow, Birch, Sellars, and Homer Creeks and Grays Lake Outlet.

Table 31. BLM water quality monitoring data.

Location	Date	Flow (cfs)	Cond. (µmhos/ cm)	Temp (F)	P.H.	TSS (mg/L)	Sed. Load (t/d)
Willow Creek, At Cloward's Crossing	8/17/94	8.03	250	70			
Willow Creek ,at Kepp's Crossing	5/04/92	51.62					
	6/20/94	24.42	265	72			
	5/23/00	112	220	65	8.63	19	5.58
	6/13/00	69.25	285	55.4	8.63	13	2.32
	7/12/00	26.08					
	8/29/00	17.28		59	8.68		
Grays Lake Outlet, below Hell Creek	8/22/94	0.62	260	63			
	5/23/00	54.42	260	63	8.5	25.5	3.58
	6/13/00	25.74	280	58	8.82	6	0.40
	7/12/00	24.16					
	8/2/00	2.2	150	66	8.8		
	8/29/00	2.4		57	9.11		
Hell Creek, above Grays Lake Outlet	5/23/00	6.58		59	8.44	36	0.61
	6/13/00	3.13	370	57	7.79	6	0.05
	7/12/00	3.66					
	8/2/00	0					
Grays Lake Outlet (Upper), above Homer Creek	8/8/83	23.46	300				
	8/17/94	1.73	195				
Tex Creek , above Pipe Creek	8/18/94	1000	60.8				
Tex Creek, below Pipe Creek	5/23/00	3.84	350	64	8.26	59	
	6/13/00	8.28	390	61	8.75	92	

Total suspended sediment is a measure of particles found in suspension. Elevated suspended sediment levels are linked to increased mortality in younger fish, particularly sac fry. Lower, less lethal concentrations induce behavioral responses, which can lead to growth reduction, avoidance, and reproductive failure.

Three levels of TSS have been recommended by DEQ for categorizing fish habitat conditions; 1) <25 mg/L, best conditions, 2) 25-80 mg/L, some effects, 3) >80 mg/L, definite effects. Based on this recommendation, four of the TSS samples shown in table 31 meet the best condition criteria, three samples fall within the range where some effects on fish survival and reproduction are evident, and one sample on Tex Creek was within the definite effects on fish habitat range. TSS data collected by IASCD in 2003 (Appendix F) show most waters in the best condition range with Birch and Meadow Creeks the exception showing levels with some effects on fish habitat. When evaluating the effects of TSS on the aquatic environment, it is important to consider concentration measurements over time. Literature states that sediment effects are dependent on the frequency and duration of exposure as much as the concentration. (DEQ 2003)

Nutrient Data

Excessive concentrations of nutrients, specifically nitrogen and phosphorous, may diminish water quality and impair beneficial uses through the process of eutrophication. According to IDAPA 58.01.02.200.06, surface waters shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growth impairing designated beneficial uses. To protect against the impairment of designated beneficial uses due to excess nutrients, numeric targets have been established by the EPA at 0.1 mg/L Total Phosphorus (TP) in streams not discharging directly into a lake or reservoir, 0.05 mg/L TP in streams were the water enters the reservoir, and 0.3 mg/L nitrate (NO_3) + Nitrite (NO_2) Nitrogen. (EPA 1986)

Since Willow Creek and Meadow Creek flow directly into a reservoir, the TP target is 0.05 mg/L. The remaining streams in the watershed will be evaluated based on the TP target of 0.1 mg/L for streams not discharging into a reservoir. The nitrogen target will be the same for all of the streams at 0.3 mg/L nitrate + nitrite nitrogen.

Table 32 shows the nutrient associated data for five locations: one location on Willow Creek, one on Hell Creek and three locations on Grays Lake Outlet. This data was collected by the BLM in 2000. Total P measured on Grays Lake Outlet, below Hell Creek, in late August was 0.01mg/L, the same concentration as the numeric target. Data show that NO_3 + NO_2 concentrations did not exceeded the target level. Grays Lake Outlet and Hell Creek are 303(d) listed with nutrients as a pollutant. Willow Creek is not 303(d) listed for nutrients.

As shown in appendix F, nutrient data was collected by the IASCD in 2003. Sample locations were on Birch Creek, Homer Creek, Meadow Creek, Sellars Creek, Grays Lake Outlet, and Willow Creek (two locations). Water quality data collected on Birch Creek, below Squaw Creek, exceeded the criteria for phosphorous on two occasions at 0.5 mg/L on 06/03/03 and 0.2 mg/L on 6/16/03. The creek was dry on all subsequent occasions. Homer Creek water quality data, collected at the mouth, showed no exceedances. Monitoring occurred on Meadow Creek, below Squaw Creek, one minor phosphorous exceedance at 0.11 mg/L was documented on 06/13/03. Grays Lake Outlet, above the Homer Creek confluence, met the criteria for P and NO_3+NO_2 on all sample occasions in 2003. The Kepp's Crossing sample location on Willow Creek met the criteria for P and NO3+NO_2 on all nine sampling events (06/03/03-10/07/03). However, further upstream on Willow Creek at the Pole Bridge (Long Valley Road crossing) sample site, the results showed nitrogen levels above the criteria on every occasion with six samples exceeding the nitrogen criteria, averaging 0.82 mg/L. Of all the streams sampled, nutrient levels were the highest on Sellars Creek, below the Mud Creek confluence. Nitrate + nitrite levels were elevated on every occasion (nine), averaging, 0.85 mg/L. Phosphorous levels on Sellars Creek were above criteria on three occasions, with the highest reading 0.15 mg/L.

Hell Creek, Brockman Creek, and Grays Lake Outlet (Outlet to falls) are 303(d) listed with nutrients as a pollutant. The Grays Lake (above Homer Creek) sample site is the closest downstream sample location for Brockman Creek. As stated earlier, nutrient samples at that location fall below the recommended criteria. Nutrient samples collected on Grays Lake Outlet, below Hell Creek, were at or below the criteria for P and below the detection limit for nitrogen.

Table 32. Nutrient data at five BLM sample collection sites.

Location	WBID	Date	Flow (cfs)	Cond. (µmhos /cm)	Temp (C)	NO3/NO2 as N (mg/L)	TKN (mg/L)	Ortho-phosphate PO4 (mg/L)	Total P (mg/L)
Willow Creek At Kepp's Crossing	US-5	7/12/00	26.08			<0.1	0.4	0.028	0.048
		8/29/00	17.28		59	<0.1	0.33	0.012	0.037
Grays Lake Outlet below Hell Creek	US-16	8/2/00	2.2	150	65.7	<0.1	0.75	0.011	0.102
		8/29/00	2.4		56.7	<0.1	0.56	0.005	0.028
Hell Creek above Grays Lake Outlet	US-29	7/12/00	3.66			<0.1	0.36	0.017	0.028
		8/2/00	0						
Grays Lake Outlet above Hell Creek	US-17	7/12/00	24.16			<0.1	0.42	0.016	0.025
Grays Lake Outlet (Upper, above Homer Creek)	US-19	8/8/83	23.46	300					
		8/17/94	1.73	195	62.6				

Ririe Reservoir Water Quality Data

Ambient water quality monitoring is conducted on the Ririe Reservoir. The EPA maintains a data management system containing water quality information for the nation's waters. The STORET database contains water quality monitoring data for the Ririe Reservoir. This data is located on the EPA's STORET web page at www.epa.gov/STORET/. Data from 1996 through 2002 suggests that there is a slight declining trend in suspended solids and nitrate/nitrite concentrations. Total Phosphorous concentrations were highest, on average, at the reservoir sample location 0.6 miles northwest of Meadow Creek.

Biological and Other Data

Surface Fines

Since 1993 DEQ has collected water quality data through the Beneficial Use Reconnaissance Program (BURP). The BURP program characterizes water quality based on biological communities and their attributes. Assessing channel materials is an important key to evaluating the biological function and stability of streams. Channel materials consist of surface particles that make up the bed and banks within the bankfull channel. (Rosgen 1996) One method for evaluating the particle size distribution of streambed sediment is the Wolman Pebble Count. BURP crews conduct Wolman Pebble Counts utilizing a set interval method with a minimum of fifty counts per riffle in three riffle habitat units (DEQ 2002). Counts are obtained from the bankfull width on each side. Included are the margins of the streambed, which are not normally under water and may be more depositional than the main channel. A tally is kept of the size categories into which particles fall based on the intermediate axis diameter. From this data, the percentage of particles in set categories can be determined (DEQ 1998).

Sediment fines are defined as materials <6.35 mm in diameter. They are used as an index of sedimentation and beneficial use impairment (DEQ 2002). Studies have shown that many salmonid species prefer particles of this size or greater for spawning success. Studies show that spawning success is diminished when the proportion of finer materials becomes too great. Fine sediment also affects the living space of insects as well as fish (DEQ 2002).

Surface fines and related data is summarized in appendix G, DEQ BURP monitoring data. BURP sample locations are identified in figure 25. The average of percent fines is greater for non-listed streams than for listed streams however, the streambanks are more stable in the non-listed streams.   Eagle Creek North Fork, Gravel Creek, and Willow Creek2 (tributary of Grays Lake) are the non-listed streams that tend to have the lowest percentage of surface fines. Brockman Creek, Corral Creek, Grays Lake Outlet, Homer Creek, Lava Creek, Tex Creek and some portions of Willow Creek are the listed reaches that tend to have the lowest percentage surface fines. The listed and non-listed streams with lower surface fine numbers tend to reside in the upper regions of the subbasin.

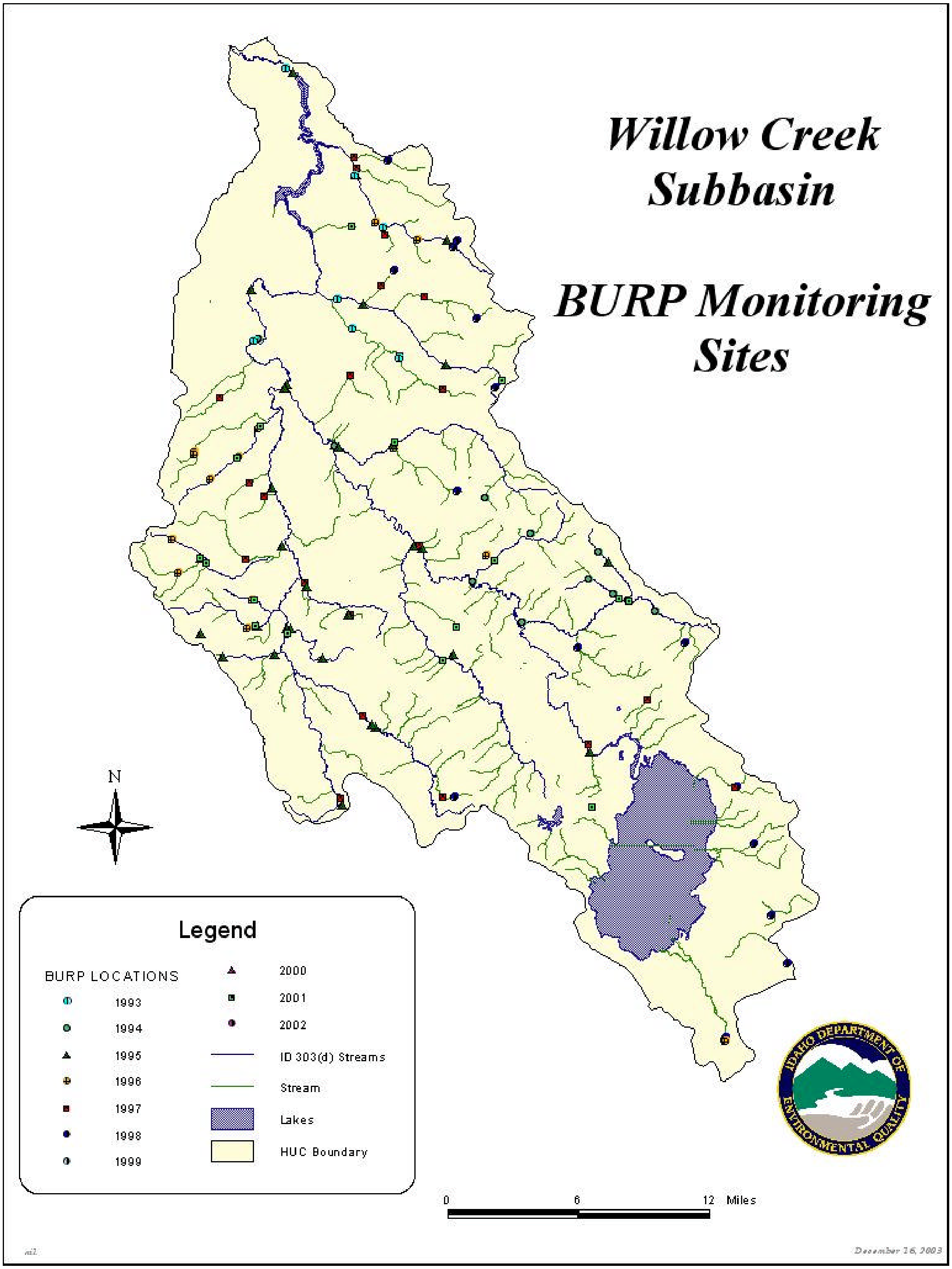

Figure 25. Willow Creek Subbasin BURP Monitoring Sites.

Subsurface Fines

Determining percent composition of surface and depth fine sediment in spawning habitat is used as a complimentary target to track changes in sediment loading over time. Since it is believed that surface fines can easily be swept away by spawning fish, subsurface sediment core samples are more biologically meaningful. Research has shown that subsurface fine sediment composition is important to egg and fry survival, Hall (1986), Reiser and White (1988). McNeil and Ahnell (1964) state that, "size composition of bottom materials greatly influences water quality by affecting rates of flow within spawning beds and ranges of exchange between intragravel and stream water". According to Bjornn, Peery, and Garmann (1998) "Salmonid embryo survival and fry emergence are inversely related to the amount of fine sediment in stream substrates." Fine sediment can decrease the amount of dissolved oxygen (DO) available to developing embryos by impeding flow of water through the substrate and through the oxidation of organic material in fine sediment. Low oxygen availability from excess fine sediment has been associated with smaller and less developed emergent fry."

McNeil Sediment Core samples can describe size composition of bottom materials in identified salmonid spawning locations. McNeil Sediment Core samples are collected by isolating a small area of the stream bottom from the current with an open stainless steel cylinder (12 in). The cylinder is worked to a depth of approximately 4-6 inches into the spawning habitat. Substrate is then removed from the cylinder, washed through a series of ten sieves (63 to .053 mm diameter openings), and then measured via volumetric displacement. Three sediment core samples are obtained for each site and averaged to calculate the percentage of depth fines at the sample location. The percentage of intergravel fines less than 6.35 mm (1/4 in) in diameter is correlated with expected fry survival.

In 2000 Millennium Science Engineering (MSE) was contracted by DEQ to perform subsurface sediment sampling at five locations in the Willow Creek Subbasin. Table 33 shows the output from the McNeil Sediment Core samples. The output shows the percent composition of fine sediment less than 6.35 mm diameter. DEQ has a target for volcanic, granitic, and sedimentary watersheds that is less than 28% fine sediment (<6.35 mm diameter) in identifiable spawning habitat. Channel morphology provides flow dynamics that result in fine sediment levels less than 28% in unperturbed conditions. Excessive fine sediment inputs or disturbed channel morphology are indicated by fine sediment compositions above 28%.

Of the streams evaluated by MSE, four of the five were above the 28% target for depth fines. Mill Creek, Sawmill Creek, and Willow Creek at Grays Lake Outlet and Kepp's Crossing were above the target level. Lava Creek was below the target level with 24% fines. All of the streams sampled for surface fines by MSE are 303(d) listed for sediment.

Table 33. MSE McNeil Sediment Core sample sites and percentage depth fines.

Stream	WBID	Date of data collection	Location	Location Description	% of fine material <6.35mm
Lava Creek	US-28	09/29/01	N 3°15'24.8" W 111°34'27.7"	Downstream of Dan Creek road crossing	24.44
Mill Creek	US-12	09/27/01	N 43°13'43" W 111°46'12.8"	Above Willow Creek	43.11
Sawmill Creek	US-27	08/31/01-09/01/01	N 43°14'13" W 111°29'24"		47.34
Willow Creek	US-5	09/26/01	N 43°22'32.9" W 111°45'32.6"	At Grays Lake Outlet	31.42
Willow Creek	US-5	09/05/01	N 43°24'33.3" W 111°47'0.2"	At Kepp's Crossing	30.69

In 2003 DEQ attempted to collect fine sediment samples, via McNeil method, on nine streams, Corral, Grays Lake Outlet, Lava, Meadow, Mill, Sawmill, Sellars, Tex, and Willow Creeks. Of the nine streams, Willow Creek, Sellars Creek, and Grays Lake Outlet had sufficient flow to properly identify spawning habitat. Streambed sediment compositions were above the 28% target on Sellars Creek and Grays Lake Outlet and below the target on Willow Creek with 24% fines. Table 34 shows the location and results of DEQ subsurface fine sampling. Appendix H contains the computation sheets for depth fine sampling.

Table 34. DEQ Sediment Core sample locations and percentage depth fines.

Stream	Date of data collection	Location	Location Description	% of fine material <6.35mm
Grays Lake Outlet	09/18/03	N 43°16'7.01" W 111°38'26"	Near Homer Creek Confluence	44.06
Sellars Creek	09/15/03	N 43°15'39.55" W 111°50'0.96"		54.27
Willow Creek	09/17/03	N 43°24'27.9" W 111°47'6.88"	At Kepp's Crossing	23.65

Streambank Assessments

DEQ utilizes streambank erosion inventories (SEI) to assess current erosion conditions within a stream. This method is very useful in identifying load reductions necessary to achieve desired future conditions that are expected to restore beneficial uses to a stream.

DEQ SEIs are conducted in accordance with methods outlined in proceedings from the Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (NRCS 1983). The NRCS technique measures streambank/channel stability, length of active eroding banks, and bank angles. Streambank and channel stability field measurements are used to ascertain the long-term lateral recession rate. The recession rate is determined from field evaluation of streambank characteristics that are assigned a categorical rating ranging from 0 to 3. The categorical ratings are summed to a cumulative rating. From the cumulative rating a lateral recession rate is assigned ranging from slight at 0.01 ft/yr. to very severe at 0.5 +

ft/yr. An average volume of eroded bank is obtained with the estimated recession rate. By applying a measured or estimated standard bulk density based on composition of streambank material an estimate of tons of sediment from streambank erosion is obtained for comparison to other reaches or for applying a load allocation based on a prescribed reference condition. Appendix I outlines the method for conducting SEIs.

It is assumed that natural background sediment loading rates from bank erosion equate to 80% bank stability as described in Overton and others (1995), where banks are expressed as a percentage of the total estimated bank length. Natural condition streambank stability potential is generally 80% or greater for Rosgen A, B, and C channel types in plutonic, volcanic, metamorphic, and sedime0.ntary geology types. Therefore, an 80% bank stability target based on streambank erosion inventories shall be the target for sediment.

Streambank erosion inventories were conducted by DEQ in 2003 on Grays Lake Outlet, Lava Creek, Meadow Creek, Mill Creek, Seventy Creek, and Willow Creek. As shown in table 35, upper Mill Creek is the only inventory site where bank stabilities meet the 80% target. The recession rate is highest at the lower Willow Creek inventory site (below Long Valley Rd crossing) being 0.61 ft/yr.

Table 35. DEQ Streambank Erosion Inventory Summary

Reach Location	Total Inventoried (ft)	Erosive (ft)	% Erosive	Ave Bank Height (ft)	Ave Recession Rate (ft/yr)
Grays Lake Outlet					
Middle	2025	873	43	2.7	0.16
Lava Creek					
Upper	270	228	84	3.7	0.16
Meadow Creek					
Upper	1240	468	38	4.1	0.12
Mill Creek					
Upper	1625	132	8	1.1	0.05
Middle	653	235	36	2.9	0.16
Lower	483	173	36	2.8	0.05
Seventy Creek					
Lower	1391	844	61	3.2	0.61
Willow Creek					
Lower	1578	790	50	1.7	0.61
Sellars Creek					
Upper	2133	1140	53	2.5	0.27
Middle	1408	1098	78	2.4	0.5

In 2001 MSE conducted streambank erosion inventories and Stream Visual Assessment Protocol (SVAP) at 25 sites in the Willow Creek watershed (Figure 26). Streambank erosion worksheets were completed to calculate a lateral recession rate for the reach. Field measurements were taken of eroding streambanks to determine the percentage of unstable streambanks along the reach, total reach erosion (tons/year), and the erosion rate (tons/mile/year). Table 36 contains a summary of streambank erosion data collected in the study.

Thirteen 303(d) listed streams were inventoried in the MSE SEI study. Brockman Creek was separated into four reach segments, one above the confluence with Corral Creek, two middle reaches between Sawmill Creek and Grays Lake Outlet and a lower reach just above the confluence with Grays Lake Outlet. On Brockman Creek 1.46 stream miles were assessed, of that, 0.61 miles contained actively eroding banks. Willow Creek was divided into three reach segments: upper, upper-middle (above Crane Creek confluence), and lower (Buck Creek confluence), at the confluence with Buck Creek. The calculated reach erosion rates on Willow Creek were between 59 and 45 tons/year (t/y). Three segments of Homer Creek were inventoried totaling 1.14 stream miles assessed with bank heights averaging 4.7 ft. The Grays Lake Outlet, upper Hell Creek, upper Lava Creek, and middle Mill Creek reaches had the least erosive banks at 20%, 16%, 19%, and 10 % respectively. Sediment loading rates for Buck, Corral, Meadow, Sawmill, and Seventy Creeks were calculated at 51, 309, 129, 330, and 24 t/mi/yr, respectively. Two reaches along Crane Creek were evaluated where lateral recession was 0.16 ft/yr in the upper reach and 0.21 ft/yr in the lower reach.

Table 36. MSE streambank assessment data summary.

Reach Location	Total Inventoried (ft)	Erosive (ft)	% Erosive	Ave Bank Height (ft)	Ave Recession Rate (ft/yr)	SVAP
Brockman Creek						
Middle	4500	2323	52	5.2	0.61	Poor
Lower	4700	2703	58	8	0.16	Poor
Buck Creek						
Lower	2150	723	48	2.4	0.16	Fair
Corral Creek						
Lower	4000	1855	46	3.8	0.27	Fair
Crane Creek						
Upper	4000	1718	43	4.8	0.16	Poor
Middle	4000	1771	44	5.5	0.16	Poor
Grays Lake Outlet						
Middle	6000	2693	45	5.1	0.38	Poor
Hell Creek						
Middle	4000	1425	36	6.9	0.16	Poor
Lower	4332	2205	51	9.5	0.27	Fair
Homer Creek						
Upper	4000	1701	43	4	0.5	Poor
Middle	4000	1269	32	4.5	0.27	Poor
Lower	4000	2510	63	4.3	0.5	Poor
Lava Creek						
Lower	4000	1807	45	3.1	0.27	Poor
Meadow Creek						
Lower	4000	814	20	4.2	0.15	Poor
Sawmill Creek						
Lower	4000	1166	29	4	0.61	Poor
Seventy Creek						
Middle	700	212	30	1.4	0.09	Poor
Willow Creek						
Upper	4000	1590	40	4.2	0.16	Poor
Upper-Middle	4000	1751	44	3.2	0.27	Fair
Lower Willow	4000	2141	54	5	0.21	Poor

Stream Visual Assessment Protocol (SVAP) is a method developed by the NRCS to evaluate stream health via a basic field assessment. Assessment protocol elements include channel condition, hydrologic alteration, riparian zone, bank stability, water appearance, nutrient enrichment, fish barriers, fish cover, pools, invertebrate habitat, canopy cover, macroinvertebrates, manure presence, salinity, and riffle embeddedness. Assessment elements are scored and stream conditions are classified as poor, fair, good, or excellent. In 2001, in conjunction with their SEI work, MSE conducted SVAPs. Stream visual assessment protocol results (Table 36) show that all streams assessed received a fair to poor rating for stream health. Upper Brockman, lower Hell, upper-middle Willow, Buck, and Corral Creek reaches were rated fair and the remaining reaches received a poor rating.

Proper Functioning Condition (PFC) is a technique utilized to determine which stream reaches are at greater risk. Inventories for PFC are conducted in the field where stream characteristics, soils, hydrology, and vegetation, are evaluated. Evaluation results are tallied and the reach is classified as being in proper functioning condition (PFC), functional at risk (FAR), or nonfunctional (NF). A stream classified as PFC is considered healthy. A classification of FAR is healthy but at risk whereas a classification of NF is considered an unhealthy reach.

The BLM (1996-2001) and IDL (1999, 2001, and 2002) have conducted PFC surveys in the subbasin on listed and non-listed streams. From 1999-2001 IDL classified a total of 40.4 stream miles as FAR, 4.94 miles as NF, and 34.14 as PFC. In the years of 1996-2001 BLM surveys resulted in a total of 15.41 stream miles as FAR, 7.81 miles as NF, and 11.29 as PFC.

Fish Data

Fish distribution and age classes are important for documentation of the existence and status of the fish in the subbasin. DEQ, IDFG, USFS, and BLM collected fish count data. Age distribution was derived from DEQ, IDFG, and USFS data, documenting the status of the aquatic life present.

In 1984, IDFG conducted a regional fishery management investigation on the Willow Creek drainage. Fish count data show that cutthroat trout is the most abundant salmonid in the drainage with Sellars and Lava Creek supporting the highest density. Brown trout, the second most plentiful salmonid, had the highest densities in Crane Creek and upper Grays Lake Outlet. Brook trout, the third most abundant salmonid, was most plentiful in Homer and Mill Creeks. Rainbow trout (*Oncorhynchus mykiss*) and rainbow x cutthroat hybrids were infrequently observed. Recent fish count data show that cutthroat trout is still the most abundant species in the subbasin with brook trout the second most common. Brown trout were absent in 1999-2002 fish surveys. The last stocking of brown trout in the watershed took place in 1998.

Corsi (1984) identified Corral and Sawmill Creeks as important Yellowstone cutthroat trout spawning tributaries. At the time, dense populations of small cutthroat were located in Corral and Sawmill Creeks (tributaries of Brockman Creek). Recent fish count data (tables

35-38) reports that there are limited salmonids in the Brockman Creek drainage. Lava and Mill Creeks also supported a relatively high density of juvenile cutthroat, attesting to their importance as cutthroat spawning and rearing habitats. Juvenile cutthroats were identified in Lava and Mill Creeks in 2002 however; their densities were much lower than those earlier recorded.

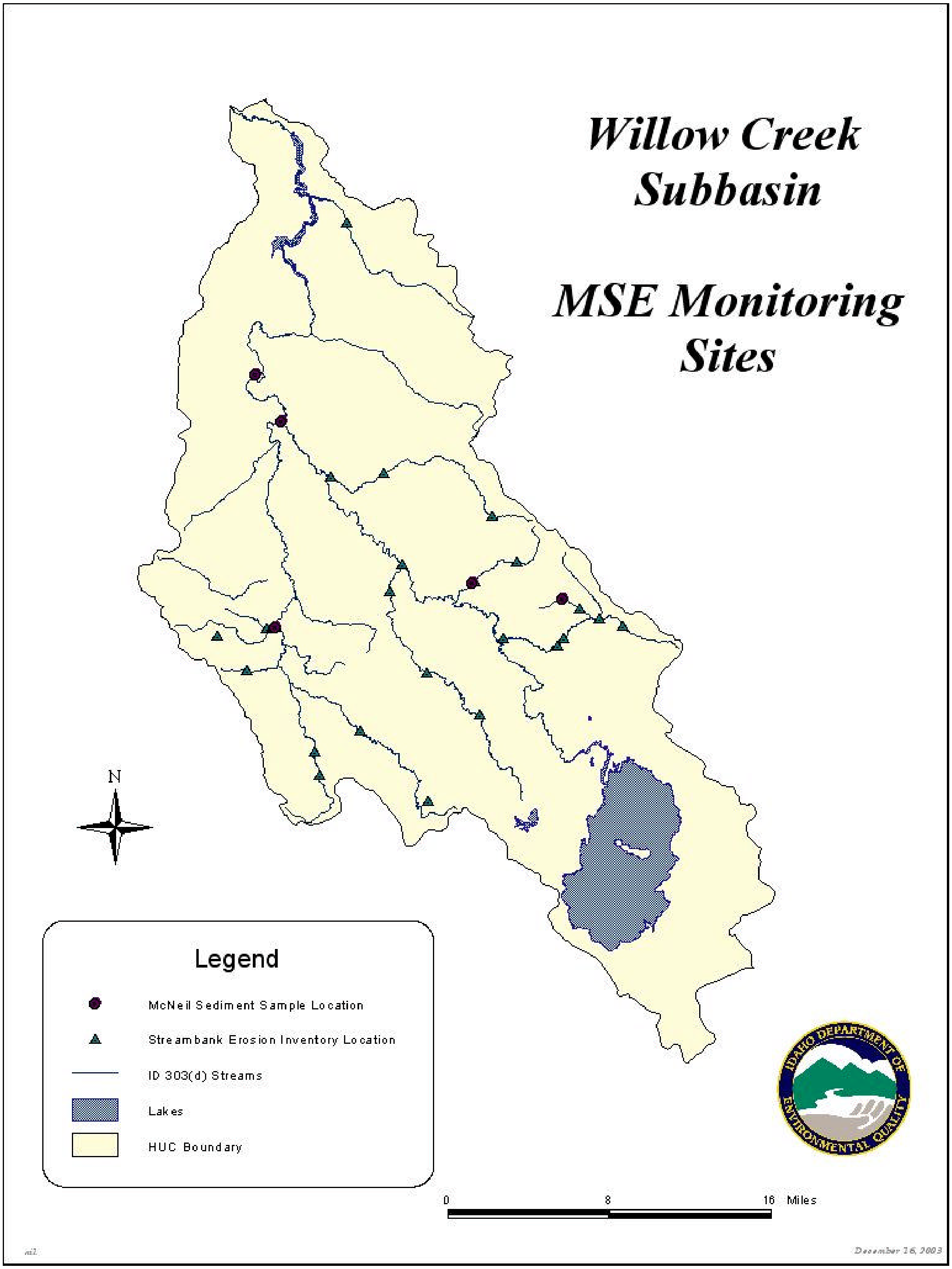

Figure 26. MSE Streambank Erosion Inventory and McNeil Sediment Sample Sites.

In 1983, it was observed that introduced rainbow trout were spawning concurrently with cutthroat trout, creating the potential for hybridization to occur. As of 1997, rainbow trout are no longer stocked in the Willow Creek Subbasin. Rainbow trout were not observed in the most recent fish count surveys, as shown in table 38.

Sellars Creek is very likely the most important tributary for cutthroat spawning in the entire Willow Creek Subbasin. Fish count data show the presence of multiple age classes however, macroinvertebrate numbers are down and habitat is impaired.

In 1985 IDFG conducted a second fishery management investigation on the Willow Creek drainage. This second study focused on the life history and status of the cutthroat trout within the Willow Creek watershed. Study findings show that two stocks of cutthroat trout exist in the drainage, resident and migratory. Resident fish spend their lives in the tributary streams whereas migratory fish emigrate from tributaries to the mainstem of Willow Creek and the Ririe Reservoir (Corsi 1985). In 1985 (Corsi) cutthroat trout were observed in all listed streams, with the exception of Long Valley Creek.

DEQ routinely conducts fish count surveys as part of their BURP assessment. Fish counts were conducted by DEQ in 1996, 1997, 1999, and 2001 as shown in appendix L, table 37. DEQ fish counts identified salmonids in seven 303(d) listed streams. Those streams were Corral Creek, Meadow Creek, Homer Creek, Mill Creek, Sellars Creek, Willow Creek, and Grays Lake Outlet. Multiple age classes were rarely observed.

Table 37. DEQ fish data summary.

Stream Name	Date Collected	YCT	BRN	BRK	RBT	Non-salmonids	comments
Birch Creek	9/30/96					sculpin	
Birch Creek	9/30/96					sculpin	
Bridge Creek	6/29/99	4					
Brockman Creek	6/30/99						no fish
Brockman Creek	6/30/99					sculpin, shiner, sucker, dace	
Brockman Creek	8/29/96					shiner, sucker, sculpin, dace	
Buck Creek	8/22/96					shiner	
Bulls Fork Creek	6/6/97						no fish
Bulls Fork Creek	6/6/97						no fish
Canyon Creek	7/1/99						no fish
Corral Creek	8/29/96	2/J				sucker, dace, shiner, sculpin	
Crane Creek	9/30/99					shiner, dace	
Crane Creek	6/29/99						no fish
Crane Creek	6/29/99						no fish
Dan Creek	8/21/96						sucker
Dan Creek	6/30/99						no fish
Deep Creek	7/1/99						no fish
Eagle Creek N Fk	6/29/99						no fish
Gravel Creek	6/29/99			7/J			
Gravel Creek	6/29/99			6			
Grays Lake Outlet	9/11/97					shiner	
Grays Lake Outlet	10/1/96					dace, shiner	shallow, algae
Grays Lake Outlet	10/1/96					sculpin, shiner, dace	

Stream Name	Date Collected	YCT	BRN	BRK	RBT	Non-salmonids	comments
Grays Lake Outlet	10/1/96	3			2	sculpin, dace, sucker, shiners, chub	
Hancock Creek	8/22/96			7/J		sculpin, speckled dace, shiner	YOY, age I & II
Hell Creek	8/21/96					sculpin	
Hell Creek	8/21/96					sucker, sculpin, speckled dace	
Homer Creek	10/1/96		1			shiner, dace	
Homer Creek	8/22/96					dace, shiner, sucker	
Indian Fk Creek	7/1/99						no fish
Lava Creek	9/3/96	6				shiner, dace, sculpin	
Lava Creek	10/1/96		3			shiner, sculpin, dace, sucker	
Long Valley Creek	8/22/96					shiner, sucker	
Long Valley Creek	7/1/99						no fish
Meadow Creek	6/29/99						no fish
Meadow Creek	7/1/99						
Meadow Creek	7/1/99	9			2		hybrids
Meadow Creek	9/30/96	76/J					Hybrids, YOY, Age 1&2.
Meadow Creek	9/30/96						low flow, hybrid
Meadow Creek	9/30/96	6					
NF Meadow Creek	7/1/99	1					hybrids
Mill Creek	8/21/96			13/J		dace, sculpin, sucker	YOY, Age I
Mud Creek	6/30/99				2	shiner, sucker	
Mudspring Creek	7/1/99						no fish
Mudspring Creek	7/1/99						no fish
Peterson Creek	7/1/99						no fish
Right Creek	7/1/99						no fish
Rock Creek	7/1/99						no access
Sawmill Creek	8/29/96					shiner, sucker, dace, sculpin	
Sawmill Creek	8/29/96					sculpin	
Sellars Creek	8/21/96	18/J				shiner	YOY, age I & II
Sellars Creek	8/1/01					sculpin	hybrids
Seventy Creek	8/22/96					shiner, sucker	
SF Sellars Creek	8/21/96	31/J				sculpin	YOY, age I & II
SF Sellars Creek	8/1/01	3				sculpin	
Shirley Creek	6/30/99					sucker, shiner, dace	
Tex Creek	9/30/96					sucker	
Twin Creek	7/1/99						no fish
W Fk Lava Creek	10/1/96					sculpin	
Willow Creek	8/21/96					sucker, shiner, dace, sculpin	
Willow Creek	8/22/96		1	7/J		dace, sculpin, shiner	YOY, age I & II
Willow Creek	6/30/99			1	3		
Willow Creek	7/1/99					sucker, shiner, sculpin	
Willow Creek							no fish
Willow Creek	8/22/01					shiner, sucker	

YCT = Yellowstone cutthroat; BRN = brown trout; BRK = brook trout; RBT = rainbow trout; YOY = Young of the Year; J = juvenile

Grays Lake Outlet and Eagle Creek are the only streams for which BLM submitted data (table 38). Counts were conducted in 1985 and salmonids were observed in North Fork Eagle Creek.

Table 38. BLM fish data summary

Stream Name	Date Collected	YCT	BRN	BRK	RBT	Non-salmonids
N Fk Eagle Creek	8/27/85	33		3		
Grays Lake Outlet	9/17/85					dace, shiner, sculpin, sucker

YCT = Yellowstone cutthroat; BRN = brown trout; BRK = brook trout; RBT = rainbow trout

In 2002 the USFS conducted fish counts in the subbasin. Table 39 summarizes their findings. USFS count data show that juvenile cutthroat trout were present in Eagle Creek. Salmonids were observed in Gravel Creek, Eagle Creek, and Willow Creek.

Table 39. USFS fish data summary

Stream Name	Date Collected	YCT	BRN	BRK	RBT	Non-salmonids	Comments
Gravel Creek	6/19/02			54			most BRK were in the 1-2 yr range
Gravel Creek	6/20/02			25			most BRK were in the 1-2 yr range
Gravel Creek	6/20/02						No Fish
Eagle Creek	6/13/02	9		30		shiner, sculpin	most BRK in 1-2 year range, most YCT in 1 yr range
Eagle Creek	6/17/02	4		49		sculpin	most BRK in 1-2 year range, most YCT in 2 yr range
Eagle Creek	6/17/02			9			most fish were in the 1-2 year range
N Fk Eagle Creek	6/11/02	27					most YCT YOY and 1 Year
N Fk Eagle Creek	6/12/02	23					most YCT YOY and 1 Year
N Fk Eagle Creek	6/12/02						No Fish
Bridge Creek	7/31/02						No Fish
Bridge Creek	7/31/02						No Fish
Bridge Creek	7/31/02						No Fish
Wayan Creek	7/23/02						Too Dry
Willow Creek	6/18/02					redside shiner, longnosed dace	
Willow Creek	6/18/02	3		11			most YCT YOY, most BRK 1 yr
Willow Creek	6/19/02						No Fish
N Fk Willow Creek	6/19/02	2		2			YCT 1 yr, BRK 1 yr
N Fk Willow Creek	6/19/02						No Fish
N Fk Willow Creek	6/19/02						No Fish

YCT = Yellowstone cutthroat; BRN = brown trout; BRK = brook trout; RBT = rainbow trout; YOY = Young of the Year

Idaho Fish and Game collected fish data in 2001, as shown in table 40. Yellowstone cutthroat trout were identified in Alley Lyons Creek, Brockman Creek, Mill Creek, Lava Creek, Sellars Creek, Sawmill Creek, and Tex Creek. Cutthroat trout were most abundant in Sellars Creek. Fish numbers were much lower in the other streams.

Table 40. IDFG fish data summary

Creek Name	Date Collected	YCT	BRN	BRK	Non-salmonids	comments
Alley Lyons Creek	7/29/01	13				most 1 yr with very little 2 yr
Alley Lyons Creek	7/29/01	1			mottled sculpin	1 yr
Birch Creek	7/30/01					no fish
Birch Creek	7/30/01					no fish
Brockman Creek	7/26/01				sucker, shiner, dace, sculpin	
Brockman Creek	7/27/01	4				YCT 1yr
Brockman Creek	7/27/01				shiner, dace,	
Gravel Creek	8/13/01			94		YOY, age 1-2
Hancock Creek	7/31/01				speckled dace, redside	
Homer Creek	7/30/01					puddled, fish dying
Mill Creek	7/26/01	3		4	shiner, dace, sucker, sculpin	YCT 1 yr, BRK 1-2 yr
Mill Creek	7/28/01			2	mottled sculpin	1- 2 yr
Mill Creek	7/28/01	9		9		YCT 1 yr, BRK 1-2 yr
Mud Creek	7/30/01					no fish
Mud Creek	7/30/01					no fish
N Fk Lava Creek	7/27/01	6			mottled sculpin	1 yr
N Fk Lava Creek	7/27/01	3			piute sculpin	1 yr
S Fk Sellars Creek	7/27/01	72			sculpin	majority in 1 yr range with a few in 2 yr
S Fk Sellars Creek	7/28/01	107			piute sculpin	1 and 2 yr range
S Fk Sellars Creek	7/28/01	32			piute sculpin	mostly YOY and 1 yr. Very little 2 yr
Sawmill Creek	7/26/01				mottled sculpin, speckled dace	
Sawmill Creek	7/26/01	3				1-2 yr
Sawmill Creek	7/29/01					Muddy, no habitat
Sellars Creek	7/26/01	18				2 yr with some 3 yr
Sellars Creek	7/29/01	103				YCT 1 yr
Sellars Creek	7/29/01	4			shiner, sucker, sculpin	YCT 2 yr
Sellars Creek	7/30/01	13			mtn sucker, mottled sculpin	YCT 1 yr
Squaw Creek	7/30/01				sculpin	
Squaw Creek	7/30/01				mtn sucker, mottled sculpin	
Tex Creek	7/25/01	6			Utah sucker	2-3 yr
Tex Creek	7/27/01					Dry

YCT = Yellowstone cutthroat; BRN = brown trout; BRK = brook trout; YOY = Young of the Year

Macroinvertebrate Data

Aquatic insects are an integral component of stream ecosystems. Anthropogenic stressors on aquatic ecosystems can affect the diversity and abundance of stream macroinvertebrates. DEQ uses BURP data to evaluate a stream's ability to support cold water aquatic life. This is accomplished by calculating the stream macroinvertebrate index (SMI) from the BURP water quality data. From the SMI, a condition ranking of 1, 2, or 3 is assigned to the site based on percentile categories of the reference conditions. WBAGII (DEQ 2002) outlines the methodology behind SMI development and calculations. Macroinvertebrate communities are considered not fully supported if the condition ranking score is less than one. As shown in appendix K, condition rankings below one are evident in several streams within the Willow Creek Subbasin.

Status of Beneficial Uses

The data presented in this section confirms that the beneficial uses for salmonid spawning (SS) and cold water aquatic life (CWAL) for listed streams within the Willow Creek Subbasin are not fully supported. Almost all of the 303(d) listed streams evaluated in streambank erosion inventories had bank stabilities less than 80%. Depth fine data show that the majority of streams sampled for sediment exceed the sediment target of 28%.

Thermograph data collected within the subbasin show that water temperatures exceed the temperature criteria for salmonid spawning in every stream sampled. Fish have been observed in all of the 303(d) listed streams where temperature data is available. It is assumed that salmonid spawning may occur in all of the temperature-impaired streams.

Historic fish data compared with current fish data show that salmonid populations were, in the past, denser and widely distributed.

Conclusions

Brockman Creek, Grays Lake Outlet (Grays Lake to above falls), and Hell Creek are all listed for nutrients. Nutrient concentrations on Grays Lake Outlet, above the Homer Creek confluence, were below the EPA recommended criteria. The Brockman Creek confluence is upstream from this location and it is believed nutrient concentrations on Brockman Creek are similar. Nutrient data is available for Grays Lake Outlet at the Hell Creek confluence. The EPA suggested criteria for total phosphorous and nitrate + nitrite nitrogen were met at this location. Because data show that stream nutrient levels are below the EPA recommended criteria, nutrient TMDLs will not be developed for Hell Creek and Brockman Creek.

The section of Grays Lake Outlet that is listed for nutrients is directly downstream of Grays Lake (Grays Lake to falls). Flow data show that this reach of Grays Lake Outlet receives very limited flow. Low or lack of flow conditions are a limiting factor to the reduction of nutrient levels and ultimate beneficial use support above the falls on Grays Lake Outlet. Because of this, a Nutrient TMDL is not warranted for this section of Grays Lake Outlet.

Nutrient levels above the total phosphorous and/or nitrate + nitrite nitrogen recommended criteria were documented several times in Sellars Creek and Willow Creek (Pole Bridge). Nuisance levels of algae growth were observed in Willow Creek and dissolved oxygen (DO) levels in the water column are nearing the cold water minimum, for salmonid survival (4 mg/L) (EPA 1986). Water quality data and field observations show that a nutrient TMDL is warranted for Willow Creek to control and limit the production of deleterious quantities of aquatic plant growth.

In Sellars Creek deleterious levels of aquatic plant growth were not observed and recorded DO levels were above the acute toxicity level for salmonids. Based on field observations, Idaho's narrative water quality criteria, and water column data, it is determined that a nutrient TMDL is not warranted for Sellars Creek. It is inferred that through the sediment TMDL; improved riparian vegetation, higher streambank stability, and modified grazing activities will bring about a reduction in overall nutrient loading to Sellars Creek.

TMDLs are warranted for all of the streams 303(d) listed for sediment, unless the stream is dewatered a majority of the year. Low flow or lack of flow limits beneficial use support therefore flow alteration is the pollutant of concern. Existing field data show that Willow Creek (below Ririe Reservoir), Sellars Creek, Seventy Creek, Long Valley Creek, Birch Creek, and Grays Lake Outlet are, to some extent, anthropogenically flow altered. Birch Creek, Long Valley Creek, and Grays Lake Outlet from Grays Lake to the fall, are flow altered to the extent that it is reasonable to say that beneficial use support is impossible in such low or no flow conditions.

Sediment is the sole listed pollutant on Birch Creek. There are two water impoundment structures on Birch Creek, one above (2.7 stream miles) and one below (down stream of the crossing) Bone Road. Both structures serve as fish barriers and sediment catchment basins. Since Birch Creek is anthropogenically dewatered, beneficial use support attainment is unlikely, until flow is restored.

Streambank stabilities on Long Valley Creek were observed below the >80% target. Robinson Reservoir, on upper Long Valley Creek, is constructed of an earthen dam to impound spring runoff waters for irrigation. It can be inferred that the attainment of beneficial use support in Long Valley Creek is not probable due to low or non-existent flow conditions the majority of the year. Because of natural and anthropogenic flow alterations, TMDLs will not be written for Long Valley Creek.

McNeil core sample data showed elevated levels of fine sediment in salmonid spawning habitat on Sellars Creek, Mill Creek, Sawmill Creek, and Willow Creek (Kepp's Crossing, Grays Lake Outlet confluence, Homer Creek confluence). McNeil sampling identified more than 28% fine sediment in Mill Creek, Sellars Creek, Willow Creek, and Sawmill Creek. Therefore, it is recommended that a load reduction target be set for these streams. Based on McNeil sampling data, sediment TMDLs may be warranted on all tributaries of Willow Creek above the Grays Lake Outlet because they have the potential to serve as sediment transport reaches.

A McNeil sediment sample on Lava Creek, downstream of the Dan Creek road crossing, showed 24% subsurface fines in the salmonid spawning habitat. Despite meeting the DEQ target, a sediment TMDL will be written for this reach because streambank erosion inventory data on the upper and lower portions of Lava Creek show that the streambank stabilities are low.

Stream temperature data is available to provide a measurement of the temperature regimes throughout the Willow Creek Subbasin. Temperature data showed elevated stream temperatures are common throughout the watershed. Temperature load allocations will be developed for all temperature-listed streams in the subbasin, except Seventy Creek. Flow appears to be the limiting factor where Seventy Creek is concerned. Low flow conditions from continuous low water years may be partly responsible for elevated stream temperatures.

Temperature data was provided for several non-listed streams. Elevated temperatures were observed in every stream where data was provided. Major exceedances were documented on non-listed streams (Hell, Homer, Brockman, and Tex Creeks) therefore, temperature TMDLs will be developed in response.

2.4 Data Gaps

Biological and water quality data was collected in the subbasin and it was available for analysis. Subsurface fine sediment data is extremely important in assessing sediment impacts on salmonid spawning habitat. Unfortunately, available depth fine data was limited. The absence of depth fine data is due, mostly, to the extremely dry conditions experienced in the watershed over the past several years. It is extremely difficult to identify spawning habitat for streambed sampling in dry stream conditions. When flow conditions allow for subsurface sediment monitoring, McNeil streambed sampling should be conducted to provide a more accurate assessment of sedimentation impacts on salmonid spawning. Table 41 shows the streams where additional data are needed.

Sediment data are not required for Birch Creek since it too is flow altered. Temperature data are not available for Seventy Creek, however it is expected that low flow conditions prohibit temperatures from meeting the salmonid spawning criteria. Nutrient, sediment, and temperature data are not needed for Grays Lake Outlet above the falls, since flow alteration is the primary source of impairment.

Additional streambank erosion inventories on all listed reaches could provide for a more detailed analysis of overall streambank conditions and sediment loading.

The salmonid spawning criteria set in this TMDL should also be further evaluated during the implementation of this TMDL to ensure that the standards set are reflective of the spawning time periods in the Willow Creek Subbasin.

Table 41. Data gaps in the Willow Creek Subbasin.

1998 303(d) Listed Segment	Listed Pollutant	Data Gaps
Birch Creek	Sediment	No sediment data
Brockman Creek	Sediment	No depth fine data
Corral Creek	Sediment	No depth fine data
Grays Lake Outlet (Grays Lake to above falls)	Nutrient Sediment Temperature	Nutrient data is below the reach No sediment data No depth fine data Temperature data is below the reach
Hell Creek	Sediment	No depth fine data
Homer Creek	Sediment	No depth fine data
Long Valley Creek	Sediment	No sediment data
Meadow Creek	Sediment	No depth fine data
Rock Creek	Temperature	No temperature data
Seventy Creek	Temperature	No temperature data
Tex Creek	Sediment	No depth fine data
Willow Creek (Ririe Reservoir to HUC boundary)	Sediment Temperature	No sediment data No temperature data